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TESTS made in New York State in 1956-60 indicate that the portable knapsack mistblower has considerable promise for practical control of the white-pine weevil, now the major insect enemy of white pine in the Northeast. Lindane and malathion, alone and with Aroclor 5460, were the toxicants used in the tests.

Past Attempts at Control

Early methods of control were based on silvicultural treatment and reclamation of damaged stands (*1*). Potts, Cline, and McIntyre (*5*) in 1942 reviewed these methods in the introduction to their report of what probably was the first successful chemical control of the weevil: application of concentrated lead arsenate sprays with a compressed-air knapsack sprayer. In 1954 Crosby (2) recommended procedures for white-pine weevil control based on this earlier work. Later (3) he recommended several hydrocarbon insecticides formulated with water as emulsions for application with compressed-air knapsack sprayer to control this insect in the fall or spring.

Hastings (*4*), reporting in 1956 on preliminary tests with granular endrin, obtained complete kill of caged weevils in treated duff over the winter months. Tests with several other hydrocarbon insecticides, using the same method, also gave complete kill of the hibernating weevils (unpublished data). Two field tests using granular aldrin and heptachlor in fall and spring applications were not successful[1,2].

Small-scale experiments in 1958 with a knapsack mistblower using 1 percent lindane plus 1 percent Aroclor 5460[3] as an emulsion were not successful. Later tests with 6 percent DDT or 4 percent lindane plus 4 percent Aroclor 5460 did give promising weevil control.[4,5] These tests led to further work on a larger scale in 1959 and 1960, including a pilot test in New York. This is a report of that work.

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[1]Hastings, A. R. A field test of granular insecticides for control of the white-pine weevil during hibernation. Northeast. Forest Expt. Sta. office rpt. New Haven, 1959.

[2]Hastings, A. R. A field test of granular insecticides applied by power duster for white-pine weevil control. Northeast. Forest Expt. Sta. office rpt. New Haven, 1960.

[3]A chlorinated terphenyl, used as an extender for the insecticide residue, manufactured by Monsanto Chemical Co., St. Louis, Mo.

[4]Connola, D. P. Report on spring 1959 portable mistblower spray tests for control of the white-pine weevil. N.Y. State Museum and Sci. Serv. Rpt. Albany, 1959.

[5]Connola, D. P. Annual report of the forest insect studies for field season 1959. N.Y. State Museum and Sci. Serv. Rpt. Albany, 1959.

The Tests

The equipment used in all tests was the Kiekens Whirlwind knapsack mistblower, Series 60.[6] This machine is powered with a 2-cycle 1½ h.p. gasoline motor that drives a fan capable of delivering 200 cubic feet of air per minute at full speed. The spray tank, 1⅓ gallons (U.S.) capacity, is suspended in front of the operator for safety and ease in replacement or refilling. A nozzle valve controls the amount of spray independently of the operation of the motor. Fully loaded, the machine weighs about 31 pounds.

Lindane and malathion, alone and with Aroclor 5460, were the two toxicants used in these tests. They were formulated to give 1 pound of toxicant plus 1 pound of Aroclor (when used) per 2 gallons of spray per acre. Water or fuel oil were used as the diluents. In all cases except one the applications were made to two rows of trees at once from one direction. The exception was one test in which three rows were treated as a single swath.

The test plots in New York State ranged from 0.5 to 9.0 acres. A total of 44.25 acres were treated in the individual small-scale tests and 64.9 acres in the pilot project. Plots for the individual series of tests were located in Tompkins County (4 plots), Tioga County (3), Franklin County (5), and Otsego County (*1*). The pilot project was conducted in Allegany County (18 plots).

Field crews for the pilot operation were provided by the New York State Conservation Department. All the men participating had experience in the operation of the mistblower. Three 2-man crews were used, each crew treating three plots with each toxicant.

The treatment data and results obtained in the individual plot series are given in table 1. The treatment data and results obtained in the pilot-scale operation are given in table 2.

[6]Kiekens Whirlwind Holland, N.V. Dutch Mistblower Factories. Eastern U.S. Sales Div., Vandermolen Export Co., Nutley, N.J.

Discussion

Individual test series.—None of the four fall treatments gave fully satisfactory control of the weevil in the year after application, although in each plot some reduction in damage was found. The surviving weevil population, as indicated by the percentage of weeviled trees in 1960, is still high enough to do serious injury.

The spring treatments all gave excellent weevil control for the season of treatment. The single test where three rows were treated as a single swath did not give as great a degree of control as the two-row swath treatments. This may be the limit of effective swath width for this size of tree (7 feet).

Pilot control project.—The results of this field test were more variable than the individual test series. To some degree this may be due to the physical setup of the project as compared to the individual test series.

The data on the number of trees weeviled in the year of treatment (1960) were transformed to degrees and subjected to an

Table 1.—Treatment data and results obtained with mistblower applications of lindane and malathion

INDIVIDUAL TESTS: NEW YORK, 1959-60

Test No.	No. acres	Tree height (feet)	Date treated	Toxicant	Diluent	Application (minutes per acre)	Percent weeviling	
							Before treatment	After treatment
1	3.0	3	4/9/59	Lindane + Aroclor	Water	20	33.0	0.0
	3.0	3	--	Check	--	--	30.0	23.3
2	.5	8	4/21/60	Lindane + Aroclor	Oil	30	16.0	1.5
	1.0	8	--	Check	--	--	15.0	15.0
3	1.0	8	4/20/60	Lindane	Water	30	10.0	1.0
	1.0	8	--	Check	--	--	12.0	11.0
4	4.5	7	4/15/60	Lindane + Aroclor	Water	30	38.0	.08
	2.0	7	--	Check	--	--	41.0	22.0
5	3.5	7	4/16/60	Lindane + Aroclor	Water	30	33.0	*7.0
	2.0	7	--	Check	--	--	38.0	32.0
6	1.0	6	4/21/60	Lindane + Aroclor	Water	30	8.0	1.0
	1.0	6	--	Check	--	--	8.0	7.5
7	9.0	5	4/19/60	Lindane + Aroclor	Water	30	16.0	.34
8	7.0	5	4/15/60	Lindane + Aroclor	Water	30	16.0	.09
	5.0	5	--	Check	--	--	17.0	16.8
9	5.0	6	9/22/59	Lindane + Aroclor	Water	28	23.3	10.6
10	6.5	6	9/23/59	Malathion + Aroclor	Water	23	37.0	28.0
11	2.0	5	9/24/59	Malathion + Aroclor	Water	19	27.0	22.0
12	1.25	5	9/24/59	Lindane + Aroclor	Water	33	34.0	14.6
	2.5	5	--	Check	--	--	37.0	38.0

*Three-row swath treatment.

Table 2.—Treatment data and results obtained with mistblower applications of lindane and malathion

PILOT-SCALE CONTROL PROGRAM: ALLEGANY COUNTY, N. Y., 1960

Plot No.	No. acres	Tree height (feet)	Date treated	Toxicant*	Crew	Percent weeviling	
						Before treatment	After treatment
1	3.0	6-10	4/7/60	Malathion	B	33.0	19.5
2	2.0	6-10	4/8/60	Lindane	A	35.0	13.5
3	2.0	6-10	4/7/60	Malathion	C	36.0	14.6
4	2.0	6-10	4/11/60	Lindane	B	34.0	10.9
5	4.9	6-10	4/7/60	Lindane	B	27.0	2.5
6	3.2	6-10	4/6/60	Lindane	B	29.0	4.5
7	2.0	4-8	4/6/60	Lindane	C	24.0	2.1
8	2.0	4-8	4/7/60	Malathion	C	21.0	10.6
9	3.0	6-8	4/7/60	Malathion	A	39.0	8.3
10	3.0	6-8	4/7/60	Malathion	A	43.0	30.2
11	2.4	6-8	4/10/60	Lindane	A	22.0	6.1
12	3.6	10-12	4/10/60	Lindane	A	23.0	2.2
13	4.2	10-12	4/8 & 4/11/60	Malathion	C	11.0	7.4
14	4.2	10-12	4/11/60	Malathion	B	11.0	7.8
15	6.7	6-10	4/11/60	Malathion	A	20.0	7.5
16	5.1	6-10	4/11/60	Lindane	A	18.0	2.3
17	7.6	6-10	4/8/60	Malathion	B	18.0	4.3
18	4.0	6-10	4/11/60	Lindane	C	17.0	.8

*All treatments include Aroclor 5460 at 1 pound per acre. Diluent used on all plots was No. 1 fuel oil.

analysis of variance (table 3). The data for one plot were omitted in the analysis because this plot was treated incorrectly. Lindane gave significantly better control than malathion. There was no significant difference between treatments as applied by different crews.

In this series of tests a fluorescent dye (Fluorol 7-GA)[7] was mixed with the spray used on several plots to facilitate the assessment of spray coverage on the trees. Examination of the trees in these plots was made at night with a portable battery-powered ultraviolet light[8] during the week after treatment. These observations revealed a thorough coverage of spray on all

[7]General Dyestuff Div., General Aniline & Film Corp., New York, N.Y.

[8]Mineralite Model SL-2537, Ultraviolet Products, Inc., South Pasadena, Calif.; Model BFL-6, Black Light Eastern Corp., Bayside, N. J.

Table 3.—Analysis of variance in number of trees weeviled in 1960 following treatment, pilot-control project, Allegany County, N. Y.

Source	Degrees of freedom	Sum of squares	Mean square	F
Toxicant	1	281.2401	281.2401	*7.32
Crews	2	88.8799	44.4395	1.15
Error	13	499.5276	38.4252	--
Total	16	869.6476	--	--

*Significant at 5-percent level.

sides of the upper third of the trees in the rows nearest the operator. On the alternate rows good coverage was obtained on the side nearest the operator and light coverage on the opposite side. There was no noticeable difference in the coverage obtained by different crews.

The difference in the formulation of the spray—water vs. oil—in the two series may account for some of the differences obtained in control. Connola[5] has reported that water emulsions of DDT gave better control than similar spray solutions formulated with oil (kerosene). This factor has not been sufficiently tested as yet to make a full evaluation of its importance.

Crosby (3) has given the following estimates of spray and time required for the leader treatment with hydraulic compressed air knapsack-sprayer treatments: 1 gallon of spray covers 320 trees 3 to 8 feet tall. Thus, when treating all trees, 3⅞ gallons of spray would be needed per acre (6 x 6 planting). This was almost twice the rate of application in the tests reported here.

Time to complete a treatment is also an important factor to be considered, because of manpower availability and cost. Data on the treatment time per acre were taken only on the individual tests series of plots. Most of these plots were treated in 30 minutes per acre or less actual spraying time. By comparison, the compressed-air sprayer requires 2.7 hours per acre when 450 trees per hour are treated (6 x 6 planting).

Summary

A total of 44.25 and 64.9 acres in an individual plot series and in a pilot control project, respectively, were sprayed with a portable knapsack mistblower. These treatments, using one pound of toxicant (lindane or malathion with Aroclor 5460) in 2 gallons of spray per acre, appear promising for control of the white-pine weevil. Spring applications, made just before or at weevil emergence, were more effective than fall applications. Compared to earlier recommended compressed-air knapsack-sprayer leader treatment, the time and cost of the treatment may be materially reduced.

At present, details of the optimum swath width for various tree spacings and heights have not been determined.

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